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Method of transmitting broadcast control logic channels in a cellular radio system

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ABSTRACT

The invention relates to a method whereby a base station in a digital cellular radio communication system transmits broadcast control logic channels. The broadcast control logic channels are multiplexed with one another and optionally with other logic channels such as, in particular, common control logic channels and/or independent dedicated control logic channels, on at least one physical channel constituted by the recurrence of a particular time slot in each frame of a carrier. A distinction is drawn between a first set of channels comprising broadcast control logic channel(s) carrying data that is useful for implementing handovers between cells, and a second set of channels comprising the broadcast control logic channel(s) carrying data that is not useful for implementing handovers. The logic channel(s) of the first set are carried by a first physical channel while those of the second set are carried by a second physical channel.

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ORIGINAL
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STANDARD PATENT

Invention Title:

" METHOD OF TRANSMITTING BROADCAST CONTROL LOGIC CHANNELS IN A CELLULAR RADIO SYSTEM "

The following statement is a full description of this invention, including the best method of performing it known to us:-

METHOD OF TRANSMITTING BROADCAST CONTROL LOGIC CHANNELS IN A CELLULAR RADIO SYSTEM

This invention relates to digital cellular systems for radio communication with mobile stations, such as those implementing the public GSM standard.

The term "GSM standard" is used herein to cover both the GSM 900 standard ("Global System for Mobile communications" operating in the 900 MHz band) and the DCS 1800 standard ("Digital Cellular System" operating in the 1800 MHz band).

More precisely, the invention relates to a method whereby a base station in a digital cellular radio communication system transmits broadcast control logic channels.

It is recalled that in general, a digital cellular radio communication system is implemented within a network of geographical cells through which mobile stations travel. A base station is associated with each cell and a mobile station communicates via the base station associated with the cell in which it is to be found.

It is also recalled that each base station makes use of a certain number of control logic channels (also called signalling logic channels) for transmitting signalling to the mobile stations (down link).

In general, these down link control logic channels comprise:

- broadcast control logic channels (point to multipoint channels). In the GSM standard, these comprise in particular the BCCH, FCH, and SCH channels;
- common control logic channels (point to multipoint channels). In the GSM standard, these comprise in particular the AGCH and the PCH channels;
- independent dedicated control logic channels (point to point channels). In the GSM standard, these comprise in particular SDCCH channels; and
- associated control logic channels (point to point channels), In the GSM standard these comprise in particular the SACCH and the FACCH channels.

In the context of the present invention, only broadcast control logic channels are of interest. Thus, in GSM, each base station transmits the following broadcast control logic channels:

- a BCCH channel (for Broadcast Control CHannel") which supplies all mobile stations with general data concerning the network, the cell in which the mobile station is to be found, and the adjacent cells;
- an SCH channel (for "Synchronization CHannel") which carries data enabling

frames to be synchronized and enabling the transmitter of the base station to be identified. The FCH channel is also referred to as the time synchronization channel; and

- an FCH channel (for "Frequency CHannel") which gives data concerning the carrier used. The FCH channel is also referred to as the frequency synchronization channel.

It should observed that in GSM, the broadcast control logic channels are sometimes referred to as a whole by the term "BCCH channels" which is misleading since the BCCH channels constitute only one of the families of broadcast control logic channels (with the other families being the FCH and SCH channels).

Conventionally, all of the broadcast control logic channels are multiplexed together, possibly with other logic channels and in particular with common control logic channels (AGCH, PCH) and/or independent dedicated control logic channels (SDCCH) on a single physical channel. The single physical channel is constituted by a particular recurring time slot in each frame of a particular carrier. In GSM, this is the recurring first time slot in each frame of the down link BCCH carrier.

In conventional manner, each base station (and thus each cell) uses one or more pairs of radio carriers, including necessarily a pair of BCCH carriers specific thereto. The carriers in a given pair are used respectively for the up link (mobile station to base station) and for the down link (base station to mobile station).

Each carrier is segmented in time by using a fixed time division multiple access (TDMA) scheme. In this scheme, the time axis is subdivided into successive frames of fixed duration, each frame itself being subdivided into a determined number of time slots, with the recurrence of a particular time slot in each frame constituting a physical channel on which a plurality of logic channels can be multiplexed.

It turns out that the present solution as described above which consists in using a single physical channel to transmit all of the broadcast control logic channels is not entirely satisfactory.

Using a single physical channel impedes high effectiveness during pre-synchronization of a mobile station for the purpose of implementing a transfer between cells, known as "handover".

It will be understood that because of the large number of logic channels

multiplexed on the single physical channel, reading channels that are essential for handover is delayed, and handover performance is slowed down. In other words, handovers are not optimized because the time necessary for acquiring essential data for a handover is lengthened by an amount related to the fact that other data occupies a large portion of the data rate of the physical channel used.

This constraint is particularly troublesome in a microcellular environment for handovers decided by the mobile station.

It is observed that in a microcellular network (e.g. of the Manhattan type) where a mobile station can change cell very quickly and without good visibility over adjacent cells, this synchronization delay can even lead to a call being lost.

An object of the present invention is to mitigate this major drawback of the state of the art.

More precisely, one of the objects of the present invention is to provide a method whereby a base station in a digital cellular radio communication system can transmit broadcast control logic channels in a manner making it possible for a given number of base stations to be decoded to perform handovers more quickly.

Another object of the invention is to provide such a method making it possible to increase the number of base stations that can be decoded per second by a mobile station.

According to the invention there is provided a method whereby a base station in a digital cellular radio communication system transmits broadcast control logic channels to a plurality of mobile stations,

said base station being associated with a "current" cell, said broadcast control logic channels being multiplexed with one another, and optionally with other logic control channels such as, in particular, common control logic channels and/or independent dedicated control logic channels, on at least one physical channel constituted by the recurrence of a particular time slot in each frame of a carrier,

wherein a distinction is drawn between:

- a first set of channels comprising the broadcast control logic channel(s) carrying data that is useful for implementing handovers; and
- a second set of channels comprising the broadcast control logic channel(s) carrying information that is not useful for implementing handovers;

and wherein the logic channel(s) of the first set is/are carried by a first physical channel, and the logic channel(s) of the second set is/are carried by a second physical channel.

The logic channels of the first set carry data that needs to be decoded quickly by the mobile stations since it is useful in implementing handovers. In contrast, the logic channels in the second set carry data that can be decoded more slowly by the mobile stations since it is not useful in implementing handovers.

Since each set of logic channels is transmitted over its own physical channel, the invention makes it possible to decode data more quickly. Particularly on the first physical channel carrying the logic channels of the first set, the frequency of appearance of data that is useful for handovers is increased. In contrast to the present technique as described above, the time required to acquire data that is essential for handovers is not delayed by the presence of other data occupying a large fraction of the data rate of the first physical channel. This other data is conveyed by the logic channels in the second set which are carried by the second physical channel.

By enabling data useful for handover to be decoded more quickly, the method of the invention makes it possible to increase the number of neighbouring base stations that can be decoded per second by a mobile station that is on a call. In addition, for a given number of neighbouring base stations to be decoded, the method of the invention makes it possible to perform handovers more quickly. This advantage is of great importance in cities where the target base station is identified at the last moment.

In addition, by distinguishing two classes of data, and thus two classes of broadcast control logic channels, the method of the invention provides greater flexibility.

Advantageously, said data useful for implementing handovers belongs to the group comprising:

- frequency synchronization data; and time synchronization data.

Advantageously, said data not useful for implementing handovers belongs to the group comprising:

- general data about the network;
- general data about the current cell; and

- general data about the cells adjacent to the current cell,

In a particular embodiment of the invention, said first set comprises in particular a frequency synchronization channel and a time synchronization channel, and said second set comprises in particular a channel carrying general data about the network and/or the current cell and/or the adjacent cells.

Advantageously, said first and second physical channels are carried by the same carrier.

In a variant, said first and second physical channels are carried by two distinct carriers.

In order that the invention may be readily carried into effect, embodiments thereof will now be described in relation to the figures of the accompanying drawings, in which:

- Figures 1A & 1B and Figure 2 show respectively first and second implementations of the method of the invention;
- Figure 3 shows an example of how the channels of the first set can be multiplexed on the first physical channel; and
- Figure 4 shows an example of how the channels of the second set can be multiplexed on the second physical channel.

The invention thus relates to transmitting broadcast control logic channels from a base station (BTS) in a digital cellular radio communication system.

According to the invention, a distinction is drawn between:

- a first set of channels comprising all of the broadcast control logic channels which carry data useful for implementing handovers; and
- a second set of channels comprising all of the other broadcast control logic channels (i.e. those which carry data other than data useful for implementing handovers).

Also according to the present invention, the logic channels in the first set are carried by a first physical channel while those in the second set are carried by a second physical channel.

The term "data useful for implementing handovers" is used, for example, to mean frequency synchronization data and time synchronization data.

The term "data other than data useful for implementing handovers" is used, for example, to mean general data about the network, general data about the current

cell, and general data about the cells adjacent to the current cell.

In conventional manner, a physical channel is constituted by a particular time slot that recurs in each frame of a carrier.

In a first implementation of the invention (Figures 1A and 1B), the first and second physical channels (respectively carrying the first and second sets of logic channels) are carried by two distinct carriers. Figures 1A and 1B show frames 1 and 2 belonging to respective ones of these two carriers. In this example, the first physical channel (No. 1) is constituted by the recurrence of the first time slot IT0 in each frame 1 of one of the two carriers concerned (e.g. the conventional BCCH carrier), and the second physical channel (No. 2) is constituted by the recurrence of the first time slot IT0 in each frame 2 of the other one of the two carriers concerned (e.g. a carrier of the same type as the conventional BCCH carrier).

In a second implementation of the invention (Figure 2), the first and second physical channels (carrying respectively the first and second sets of logic channels) are both carried by the same carrier (e.g. the conventional BCCH carrier). In this example, the first and second physical channels (No. 1 and No. 2 respectively) are constituted by the recurrence of the first and third time slots IT0 and IT2 respectively in each frame 3 of the carrier concerned.

The mobile stations know the frequency of said carrier or of each of said two carriers, where said frequency(ies) forms part of the data that is broadcast, for example, in one of the channels in the second set (since this data is not of use in handover).

In the description below, an application of the method of the invention is described to a system of the GSM type. Nevertheless, it is clear that the present invention can be applied to any type of digital cellular radio communication system.

Thus, in GSM, the above-mentioned first set comprises, for example, specifically a frequency synchronization channel (or FCH logic channel) and a time synchronization channel (or SCH logic channel), while the second set comprises, for example, specifically a channel for general data about the network, about the current cell, and about the adjacent cells (or BCCH logic channel) .

For each new base station to which it listens, a mobile station must decode data in a certain order, specifically:

- stage 1: frequency synchronization data (PCH logic channel) ;
- stage 2: time synchronization data (SCH logic channel); and
- stage 3: general data about the network, about the current cell, and about the adjacent cells (BCCH logic channel).

The mobile station receives the data of stages 1 and 2 via the PCH and SCH broadcast control logic channels carried by the first physical channel, and then the stage 3 data from the BCCH broadcast control logic channel carried by the second physical channel.

Since only the FCH and SCH logic channels are multiplexed on the first physical channel, the data conveyed thereby is repeated more often. Thus, a mobile station making a call and listening to this first physical channel can synchronize itself more quickly, and thus the duration of a handover is thus reduced. The second physical channel is listened to, and the corresponding data is decoded, by mobile stations that are not involved in a call.

Figure 3 shows an example of how the channels of the first set are multiplexed on the first physical channel. In this example, multiplexing makes use of a multiframe made up of 51 frames. The time slot whose recurrence constitutes the above-mentioned first physical channel comprises during frames Nos. 1 to 50 alternating bursts of the PCH logic channel ("F" in Figure 3) and of the SCH logic channel ("S" in Figure 3), with frame No. 51 being a free frame (time slot "I") .

Figure 4 shows an example of how the channels in the second set are multiplexed on the second physical channel. in this example, the multiplexing also uses a multiframe constituted by 51 frames. The time slot whose recurrence constitutes the above-mentioned second physical channel comprises bursts of the BCCH logic channel ("B" in Figure 4) occupying frames Nos. 1 to 5, and bursts of the AGCH or PCH logic channel ("C" in Figure 4) occupying frames Nos. 6 to 50, with frame No. 51 being a free frame (time slot "I").

Thus, in this example, the BCCH broadcast control logic channel of the second set is multiplexed with the AGCH and PCH common control logic channels. It is clear that it could also be multiplexed with the SDCCH independent dedicated control logic channels.

By way of comparison, in conventional GSM, all of the broadcast control logic

channels FCH, SCH, and BCCH are multiplexed with one another and with the common control logic channels AGCH and PCH (and possibly also with the independent dedicated logic control channels SDCCH) using a multiframe of 51 frames, and a single physical channel. In that conventional multiframe, the channels FCH and SCH appear five times, i.e. in frames Nos. 1, 11, 21, 31, and 41.

As can be seen clearly from Figure 3, the method of the invention makes it possible to cause the logic channels FCH and SCH to appear more often since they appear 25 times per multi-frame, once every other frame from frame No. 1 to frame No. 50. The time required for a mobile station to find the PCH channel is thus reduced and handover can take place more quickly.

Clearly numerous other implementations of the invention can be envisaged. in particular, other types at multiframe may be provided. it is also possible to add to or alter the list of channels in each of the two above-mentioned sets.

The claims defining the invention are as follows:

1. A method whereby a base station in a digital cellular radio communication system transmits broadcast control logic channels to a plurality of mobile stations,

said base station being associated with a "current" cell, said broadcast control logic channels being multiplexed with one another, and optionally with other logic control channels such as, in particular, common control logic channels and/or independent dedicated control logic channels, on at least one physical channel constituted by the recurrence of a particular time slot in each frame of a carrier,

wherein a distinction is drawn between:

- a first set of channels comprising the broadcast control logic channel(s) carrying data that is useful for implementing handovers; and
- a second set of channels comprising the broadcast control logic channel(s) carrying information that is not useful for implementing handovers;

and wherein the logic channel(s) of the first set is/are carried by a first physical channel, and the logic channel(s) of the second set is/are carried by a second physical channel.

2. A method as claimed in claim 1, wherein said data useful for implementing handovers belongs to the group comprising:

- frequency synchronization data; and
- time synchronization data.

3. A method as claimed in claim 1 or 2, wherein said data not useful for implementing handovers belongs to the group comprising:

- general data about the network;
- general data about the current cell; and
- a general data about the cells adjacent to the current cell.

4. A method as claimed in any ore of claims 1 to 3, wherein said first set comprises in particular a frequency synchronization channel and a time synchronization channel.

5. A method as claimed in any ore of claims 1 to 4, wherein said second set comprises in particular a channel carrying general data about the network and/or the current cell and/or the adjacent cells.

6. A method as claimed in any one of claims 1 to 5, wherein said first and second

physical channels are carried by the same carrier.

7. A method as claimed in any one of claims 1 to 5, wherein said first and second physical channels are carried by two distinct carriers.

8. A method substantially as herein described with reference to the accompanying drawing.

DATED THIS FOURTH DAY OF JUNE 1998

ALCATEL ~~ALSTHOM COMPAGNIE GÉNÉRALE d'ELECTRICITÉ~~

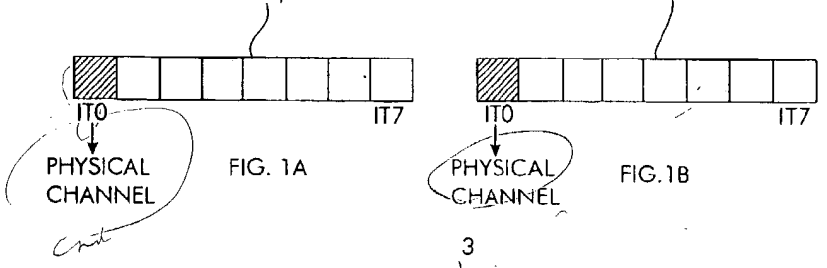

FIG. 1A FIG. 1B

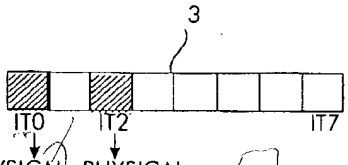

FIG. 2

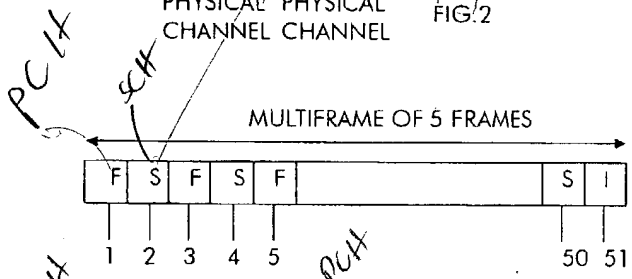

FIG. 3

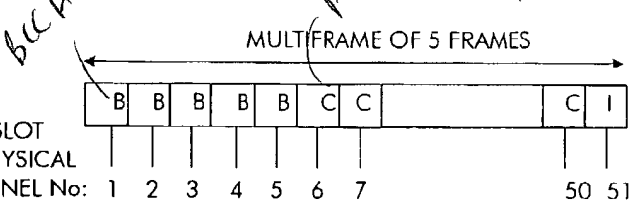

FIG. 4